REMARKS

Claims 1, 2, 4 and 8 have been amended to improve the claim language. No new matter has been added. Claims 1-12 and 15 remain presented for consideration in this application.

Claims 1-12 and 15 are rejected under 35 USC 103(a) on Admitted Prior Art (APA) in view of Uno (US 5,748,276). This rejection is respectfully traversed.

Claim 1 recites a light modulating device having a number of elements in combination. The claimed combination includes at least one pixel comprising a plurality of separately addressable sub-pixels of different areas. The area of a first separately addressable sub-pixel is smaller than the area of a second separately addressable sub-pixel. The area of the second sub-pixel is not substantially a multiple of the area of the first separately addressable sub-pixel. The first and second sub-pixels each have an equal number of selectable transmission/reflection levels more than two. The device is configured to selectively address each sub-pixel separately so as to select for that sub-pixel any one of the more than two transmission/reflection levels independently of the level selected for any other of the sub-pixels.

This combination of elements as a whole is not taught or suggested, individually or together, by APA or Uno.

The Examiner relies on APA as teaching the subject matter of claim 1 but for the area of the second sub-pixel not being substantially a multiple of the area of the first separately addressable sub-pixel, for which the Examiner refers to FIG. 1a of Uno. The Examiner contends that it would have been obvious to modify the ratio of sub-pixel areas of APA in view of the teachings of Uno to arrive at the claimed invention. Applicants respectfully disagree.

As explained in the November 3, 2008 Response, Uno does not disclose separately addressable sub-pixels. For this reason, the skilled person would not consider Uno relevant to the claimed subject matter, and therefore would find no teaching in Uno to suggest the use of separately addressable areas having a non-multiple area ratio for grayscale as claimed.

In the Response to Arguments section of the Action, however, the Examiner states that "Uno teaches sub-pixels 26a and 26b are separately addressable by controlling difference in

driving voltages, so that the transmission/reflection level of the subpixels are independently selected." Applicants respectfully disagree.

As argued previously, Uno teaches that different voltage levels are indeed supplied to the different sub-pixels. However, Uno teaches that there should be a specific relationship between the voltage applied to the different sub-pixels, and that the different sub-pixels are all driven by the same TFT. Accordingly, the voltages applied to the sub-pixels, although different, are not independent. Because Uno teaches away from independent selection of transmission levels in the sub-pixels as explained below, one of ordinary skill in the art would have had no reason to consider the teachings of Uno in the context of the device of APA to arrive at the claimed invention.

The invention as claimed in claim 1 relates to a light modulating device having at least first and second sub-pixels of different areas where each sub-pixel can be separately addressed and the area of the larger sub-pixel is not a multiple of the area of the smaller sub-pixel. An example of this separately addressable aspect can be found in FIG. 13 and the supporting text in the specification.

As shown in detail in the left hand side of FIG. 13, the illustrated pixel has a first separately addressable sub-pixel (on the left) and a second, larger, separately addressable sub-pixel (on the right). The area of the second sub-pixel is not a multiple of the area of the first sub-pixel – rather, the ratio of the illustrated areas is 3:7. Each sub-pixel in this example has the same number of distinct transmission/reflection levels and more than two such levels. In FIG. 13, each sub-pixel contains areas of three grating shapes which can be latched to a black or white state at different voltage thresholds. Thus, each sub-pixel has four transmission/reflection levels: (level 1) all areas white; (level 2) two areas white, one black; (level 3) one area white, two areas black; (level 4) all areas black.

Claim 1 recites that each sub-pixel is separately addressable and that the device is configured to select for each sub-pixel any one of various transmission/reflection levels independently of the level selected for any other sub-pixel. The dictionary definition of

independent is not dependent – as in not subject to control by others or not affiliated with a larger controlling unit. Hence, even the broadest reasonable interpretation of this claim limitation requires that a particular level can be selected for one sub-pixel which is not dependent or contingent on the level selected for the other sub-pixel.

Examples of various transmission levels that can be selected are illustrated on the right hand-side of FIG. 13. For example, consider the transmission/reflection level (1) described above which corresponds to all areas being white. For the first sub-pixel, this level can be selected with the second sub-pixel also being level 1 (illustrated as pixel grey level 0), level 2 (pixel grey level 3.5), level 3 (pixel grey level 7) or level 4 (pixel grey level 10.5). The all white level 1 can be selected for the second sub-pixel with level 1 for the first sub-pixel (pixel grey level 0) or level 2 (pixel grey level 1.5), level 3 (pixel grey level 3) or level 4 (pixel grey level 4.5).

Hence, FIG. 13 shows that for any transmission/reflection level of the first sub-pixel, each of the possible transmission/reflection levels of the second sub-pixel can be selected. The specification clearly supports the plain meaning of the claim language discussed above.

In the Action, the Examiner relies on APA on page 21, lines 16 - 25 of the specification as disclosing all of the features of claim 1 apart from the area of the second sub-pixel not being a multiple of an area of the first separately addressable sub-pixel. In particular, APA discloses at least two bits of spatial dither having n analogue latching levels (i.e., different / distinct transmission/reflection levels). As illustrated in FIG. 11 of the specification, APA shows two sub-pixels, each having four transmission/reflection levels, and the right side of FIG. 11 shows that each sub-pixel is separately addressable so that the level selected for one sub-pixel is independent of the level selected for the other sub-pixel.

However, it is noted that this section of the specification specifically teaches that the sub-pixels should be weighted (i.e., have relative areas) in the ration of 1:n:n2 etc. Thus, this section specifically teaches that the second sub-pixel should have an area which is a multiple of the first sub-pixel. This is shown in FIG. 11 where, with n being equal to four, the larger sub-pixel has

an area which is four times the area of the second sub pixel. The reason for this, as mentioned in the specification and US 6,094,187 referred to therein, is to achieve linearly spaced grey levels, i.e., grey levels where the relative brightness of each successive grey level increases linearly. A person skilled in the art would understand linearity of grey levels to be important for providing a good grey scale display, and would clearly be taught that such linearity is achieved by the specifically taught weighting of the areas of the sub-pixels. As illustrated in FIG. 11, the proportion of each pixel which switches between one grey level and the next is the same between each and every grey-level. It is also disclosed that the sub-pixels are separately addressable to achieve the various grey-levels.

For instance, consider the transition from pixel grey-level 2 to grey-level 3 to grey level 4, and imagine all white corresponds to 100% transmissive and all black corresponds to 0% transmissive. In grey level 2, the smaller (first) sub-pixel is one-third white (33% transmissive) and the second sub-pixel is all white (100% transmissive); in grey-level 3 the first sub-pixel is all black (0% transmissive) whereas the second sub-pixel is still all white (100% transmissive). In pixel grey-level 4, however, the first sub-pixel is all white (100% transmissive) whereas the second sub-pixel is two-thirds white (67% transmissive). These examples show that the transmissive level of the first sub-pixel can vary while the transmission level of the second sub-pixel stays the same, and that the transmission level of the first sub-pixel can be the same, greater or less than the transmission level of the second sub-pixel.

The Examiner alleges that Uno teaches a pixel in a light modulating device having a first separately addressable sub-pixel that has an area which is not a multiple of the area of a second separately addressable sub-pixel. The Examiner suggests that it would have been obvious to modify the modify the ratio of sub-pixel areas in the device of APA in view of the teaching of Uno in order to achieve good gradation without gradation reversal at a main viewing angle.

Foremost, Uno is not concerned with achieving grey-scale through the use of spatial dither in which the sub-pixels are separately addressable - which is the entire purpose of the APA and relevant to the present invention. Further, Uno is not concerned with a device where the

sub-pixels have more than two distinct transmission/reflection levels. The device of Uno achieves grey-scale by varying the signaling voltage as shown in FIG 3 of Uno.

In particular, Uno describes a liquid crystal device having a plurality of sub-pixels where the sub-pixels are arranged such that a signal voltage for the pixel as a whole leads to different voltages at each sub-pixel. Uno describes that a liquid crystal display unit comprises a thin-film transistor, a plurality of sub-pixels in each pixel and a control capacitor coupled in series with a liquid crystal capacitor at one or more sub-pixels. The control capacitor consists of a conducting pattern which is formed at the same time as source and drain electrodes constituting the thin film transistor (see Uno, col. 2, lines 59 - 67). FIGS. 1a – 1c of Uno show a pixel of the device described therein. FIG. 1c shows the equivalent circuit. It is clear from column 5, lines 29 – 45 of Uno that a driving voltage Vd from the TFT is supplied to the liquid crystal layer, and that a first voltage (equal to Vd) is applied to sub-pixel 21a and that a second voltage equal to Vd (Cc/(Clc2 + Cc)) is applied to sub-pixel 21b, where Cc is the capacitance of the control capacitor – which is determined by the physical characteristics of the capacitor structure – and Clc2 is the capacitance of the liquid crystal capacitor formed in the device.

Therefore, it is clear that the voltage applied to sub-pixel 21a and the voltage applied to sub-pixel 21b are thus both dependent on the voltage output from the TFT. Whatever value of driving voltage Vd is applied, the voltage applied to sub-pixel 21a is equal to Vd and the voltage applied to sub-pixel 21b is Vd/(Cc/(Clc2 + Cc)). Therefore, it is not possible in the device described in Uno for sub-pixel 21b to be applied with a (non-zero) voltage which is the same as or higher than the voltage supplied to sub-pixel 21a. Also, if Vd is zero, then zero voltage is applied to both sub-pixels. Consequently, the design of the pixel in Uno is such that the electrical signals applied to the sub-pixels are not independent. A certain value of voltage applied to sub-pixel 21a means that one value, and one value only, of voltage can be applied to sub-pixel 21b. FIG. 3 of Uno shows the effect of this on the light output from the pixel.

In particular, FIG. 3 of Uno shows how the quantity of light transmitted from sub-pixel 1 and from sub-pixel 2 varies at a given viewing angle. It is clear that variation of the signaling

voltage for the whole pixel is what causes a variation in brightness. Thus, grey-scale is not achieved by selectively activating the sub-pixels independently. Indeed, the brightness level of sub-pixel 1 and sub-pixel 2 is fixed at a given signaling voltage. Thus a brightness of 0.6 for sub-pixel 1 is only achievable with one specific signaling voltage and that voltage inherently leads to one, and only one, particular brightness of sub-pixel 2.

Thus, notwithstanding the fact that Uno fails to teach sub-pixels that have more than two selectable transmission/reflection levels, whatever degree of transmission is selected for the first sub-pixel inherently defines the degree of transmission selected for the second sub-pixel.

In the Action the Examiner refers to column 7, lines 35-40 and column 3, lines 5 -16 of Uno, and suggests that Uno teaches "controlling the ratio of the display area and difference in driving voltage between sub-pixels." However, the ratio of the area of the sub-pixels is controlled in the sense that a particular ratio is chosen at the time of manufacture. Once the device is fabricated, the ratio of the areas is fixed and cannot be varied in use. Similarly, the difference in driving voltages is fixed at the time of manufacture by the design of control capacitor. Once the structure of the capacitor has been fixed, the resulting difference in the driving voltages is fixed. Uno simply suggests that certain design considerations should be employed when fabricating an LCD – as the skilled person reading Uno would readily understand.

Therefore, the skilled person would readily appreciate that Uno teaches a variation in grey-scale by variation of signaling voltage. The reason Uno uses two sub-pixels is to account for gradation reversal that can occur at high viewing angles.

Referring to FIG. 4a of Uno, for instance, it can be seen that a single sub-pixel shows a brightness profile that drops with increasing signaling voltage to a local minimum and then increases again at higher signaling voltages. Thus, providing grey-scale by varying the signaling voltage can lead to problems at high viewing angles.

To address this problem, the device of Uno uses two sub-pixels and arranges the two pixel to be driven with voltages that are different but both dependent in a fixed way on the

signaling voltage such that the overall pixel brightness profile is smooth and does not suffer gradation reversal. To achieve the desired brightness profile, the relationship between the driving voltages applied to the sub-pixels is carefully chosen and fixed at the time of time manufacture. Thus, Uno teaches away from independent selection of transmission levels in the sub-pixels.

The skilled person therefore would clearly understand that Uno teaches achieving grey-scale in a device in an entirely different way to that taught in APA. APA relies on independent addressing of sub-pixels to provide grey-scale. Uno relies on the voltages applied to the sub-pixels having a defined relationship. Uno contains no teaching regarding a device that provides grey-scale by selecting a transmission level of one sub-pixel independently of the transmission level selected for the other pixel. Thus, there is absolutely no reason to assume that the skilled person would consider the teaching of Uno relevant to a device that provides grey-scale through spatial dither, and instead would consider that Uno teaches away from such a device. Further, APA specifically teaches independently addressable sub-pixels having areas in the ratio of 1:n:n2 etc., to achieve linearity. Uno is not concerned with independently addressable sub-pixels and instead teaches a particular ratio of areas of the sub-pixels to achieve a different (and incompatible) purpose.

As argued previously, advantages of the present invention reside partly in the realization that using non-multiple areas of sub-pixels relaxes manufacturing constraints. This is at the expense of linearity of grey levels, but the present inventors have realized that not only are non-linear grey levels acceptable, but the use of non-linear grey levels helps reduce redundancy in error containing grey-levels.

The Examiner, in the response to this argument, suggests that these features are not recited in the claims. However, the non-multiple sub-pixel areas are clearly recited in claim 1. This inevitably leads to non-linear grey-levels and so is an inherent feature of the claim. The advantage of reduced manufacturing tolerances arises through the use of non-multiple areas of sub-pixels – which feature is recited in the claims.

Accordingly, since Uno does not disclose the teachings for which is cited, and the cited references do not disclose or suggest all of the elements of claim 1, the rejection under 35 USC 103(a) of claim 1 and the claims depending thereon should be withdrawn.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue. If it is determined that a telephone conference would expedite the prosecution of this application, the Examiner is invited to telephone the undersigned at the number given below.

In the event that the transmittal letter is separated from this document and the Patent and Trademark Office determines that an extension and/or other relief is required, Applicants petition for any required relief including extensions of time and authorize the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to **Deposit Account No. 03-1952**, referencing Docket No. **527122000300**.

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Respectfully submitted,

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